CLAIMS

1. A method of determining the endpoint of an etch layer in a semiconductor element fabrication, wherein said element is comprised of at least a first material layer, a second material layer on said first material layer, said endpoint determining method comprises the steps of:

(i) determining the total emission intensity wavelength of the first material layer;

(ii) determining the total emission intensity wavelength of the second material layer;

(iii) plotting the scalar of the wavelength differential of the upper and lower layers; and

(iv) choosing the highest peak of wavelength differential as the best range of endpoint detection wavelength.

2. A method according to Claim 1 wherein the first and second material layers have endpoint emission wavelengths that is close to each other.

3. A method according to Claim 1 wherein the first material layer is a nitrogen-rich silicon layer and the second material layer is an antireflective coating (ARC) layer.

4. A method according to Claim 3 wherein

- the nitrogen-rich silicon material has the general empirical formula Si_xN_y, including silicon nitride, Si_3N_4; and
- the antireflective coating (ARC) layer is a bottom antireflective coating (BARC), including organic and inorganic BARC materials.

5. A method according to Claim 1 wherein the steps (i) and

(ii) are conducted with a recipe which is effective in etching said second material layer.

6. A method according to Claim 5 wherein

- the first material is nitrogen-rich silicon material has the general empirical formula Si_xN_y, including silicon nitride, Si_3N_4 (hereinafter "SiN"); and
- the antireflective coating (ARC) layer is a bottom antireflective coating (BARC), including organic and inorganic BARC materials.

7. A method according to Claim 6 wherein the recipe includes a plasma-etching environment having low source power, low bias power, low pressure and etch chemistries including Cl_2 and O_2.

8. A method according to Claim 7 wherein the plasma is a decoupled plasma source (DPS) having a pressure at about 0.8Pa (6 mTorr), bias power at about 55W, source power at about 350W, Cl_2 flow rate at about 47 sccm and O_2 flow rate of 47 sccm.

9. A method according to Claim 1 wherein the endpoint wavelength detection steps employ optical endpoint detection means.

10. A method according to Claim 9 wherein the optical endpoint system includes a plasma-etch optical emission-sensing and control means for use with a DPS chamber.

11. A method according to Claim 9 wherein the endpoint system is enabled to define etch-endpoint algorithms for each wafer to be etched, control the point at which etching stops,

and store the endpoint data for each etched wafer, and wherein said endpoint data trace is retrievable for any etch operation.

12. A process for etching an upper layer from a lower layer in the fabrication of a semiconductor element, comprising the steps of:

(i) determining the total emission intensity wavelength of the upper layer;

(ii) determining the total emission intensity wavelength of the lower layer;

(iii) plotting the scalar of the wavelength differential of the upper and lower layers;

(iv) choosing the highest peak of the differential graph as the best range of endpoint detection wavelength;

(v) etch said upper layer using the wavelength chosen according to step (iv) as endpoint detection.

13. A process according to Claim 12 wherein a patterned layer is formed on the upper layer prior to the etching process.

14. A process according to Claim 12 wherein at least one of steps (i) to (iv) have been predetermined and the data retrievably stored, and wherein etching step (v) is conducted upon determining the endpoint detection wavelength using such predetermined data.

15. A process according to Claim 12 wherein the upper and lower layers have endpoint emission wavelengths that is close to each other.

16. A process according to Claim 12 wherein the first

material layer is a nitrogen-rich silicon layer and the second material layer is an antireflective coating (ARC) layer.

17. A process according to Claim 16 wherein
- the nitrogen-rich silicon material has the general empirical formula Si_xN_y, including silicon nitride, Si_3N_4; and
- the antireflective coating (ARC) layer is a bottom antireflective coating (BARC), including organic and inorganic BARC materials.

18. A process according to Claim 12 wherein the steps (i) and (ii) are conducted with a recipe which is effective in etching said upper material layer.

19. A process according to Claim 17 wherein
- the first material is nitrogen-rich silicon material is SiN; and
- the antireflective coating (ARC) layer is a bottom antireflective coating (BARC), including organic and inorganic BARC materials.

20. A process according to Claim 18 wherein the recipe includes a plasma-etching environment having low source power, low bias power, low pressure and etch chemistries including Cl_2 and O_2.

21. A process according to Claim 20 wherein the plasma is a decoupled plasma source (DPS) having a pressure at about 0.80Pa (6 mTorr), bias power at about 55W, source power at about 350W, Cl_2 flow rate at about 47 sccm and O_2 flow rate of 47 sccm.

22. A process according to Claim 12 wherein the etching is conducted in an environment comprising a source power of about 250 - 450W, a bias power of about 40 - 70W, a pressure of about 0.53 - 1.1Pa (4 - 8 mTorr) and a ratio of Cl_2 flow to O_2 flow of about 0.75 - 1.25.

23. A process according to Claim 12 wherein the endpoint wavelength detection steps employ optical endpoint detection means.

24. A process according to Claim 23 wherein the optical endpoint system includes a plasma-etch optical emission-sensing and control device for use with a DPS chamber.

25. A process according to Claim 24 wherein the endpoint system is enabled to define etch-endpoint algorithms for each wafer to be etched, control the point at which etching stops, store the endpoint data for each etched wafer, and wherein such endpoint data trace is retrievable for any etch operation.

26. A process according to Claim 12 wherein the best endpoint detection wavelength range for a BARC on SiN is from about 3075 to 3135Å.

27. A process according to Claim 12 wherein:

(a) step (i) is conducted in a first etching chamber, including a DPS chamber, provided with online data transmission and control signal;

(b) step (ii) is conducted in a second etching chamber, including a DPS chamber, provided with online data transmission and control signal;

(c) at least a processor, memory and optionally data storage

means are provided in a suitable arrangement to perform steps (iii) and (iv) with the inputs from the first and second etching chambers.

28. A process according to Claim 27 wherein step (v) is conducted in a third etching chamber, including a DPS chamber, upon determining the best wavelength in step (c) as endpoint detection.

29. A process for etching a pattern on an underlying layer atop a silicon substrate in the fabrication of a semiconductor element, comprising:

(i) coating an overlying layer atop said underlying layer;

(ii) forming a negative image of said pattern atop said overlying layer by protecting areas thereon which is not to be etched;

(iii) etch the exposed areas of said overlying layer according to data obtained from a method of Claim 1; and

(iv) etch the exposed areas of said underlying layer to form said pattern on said silicon substrate.

30. A process for etching a pattern on an underlying layer in the fabrication of a semiconductor element, comprising:

(i) coating an overlying layer atop said underlying layer;

(ii) forming a negative image of said pattern atop said overlying layer by protecting areas thereon which is not to be etched;

(iii) etch the exposed areas of said overlying layer with a process according to Claim 12; and

(iv) etch the exposed areas of said underlying layer to

form said pattern on said silicon substrate.

31. An apparatus including at least an etching chamber, including decoupled plasma source chamber, arranged to implement a method according to Claim 1.

32. An apparatus including at least an etching chamber, including decoupled plasma source chamber, arranged to implement a process according to Claim 12.

33. An apparatus including at least an etching chamber, including decoupled plasma source chamber, arranged to implement a process according to Claim 29.

34. An apparatus including at least an etching chamber, including decoupled plasma source chamber, arranged to implement a process according to Claim 30.

35. A semiconductor device which has been fabricated with a process including a method according to Claim 1.

36. A semiconductor device which has been fabricated with a process including a process according to Claim 12.

37. A semiconductor device which has been fabricated with a process including a process according to Claim 29.

38. An electronic appliance including a semiconductor device according to Claim 35.

39. An electronic appliance including a semiconductor device according to Claim 36.

40. An electronic appliance including a semiconductor device according to Claim 37.

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